



## 299-E33-10 (A6853)

### Log Data Report

#### Borehole Information:

<b>Borehole:</b> 299-E33-10 (A6853)		<b>Site:</b> SW of 216-B-42 Trench			
<b>Coordinates (WA State Plane)</b>		<b>GWL (ft)<sup>1</sup>:</b> 275.5		<b>GWL Date:</b> 2/25/02	
<b>North</b>	<b>East</b>	<b>Drill Date</b>	<b>TOC<sup>2</sup> Elevation</b>	<b>Total Depth (ft)</b>	<b>Type</b>
137,258.2 m	573,255.5 m	Jan. 1955	677 ft	290	Cable Tool

#### Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded Steel	0.15	8.625	8.0	0.328	+0.15	287
Welded Steel	2.7	6.75	6.0	0.375	+2.7	122

#### Borehole Notes:

Casing stickup was measured from a reference point survey "X" engraved on top of the 6-in. casing to the ground surface. Grout is visible at the ground surface and between the 6-in. and 8-in. casings. HWIS<sup>3</sup> is the source of the TOC elevation and coordinates. Casing information (TOC reference) is reported as provided on the as-built drawing (Ledgerwood 1993) for this borehole. On 02/25/02, the borehole was swabbed, and no contamination was detected. MACTEC-ERS personnel measured groundwater depth.

#### Logging Equipment Information:

<b>Logging System:</b>	Gamma 2A	<b>Type:</b>	SGLS (35%)
<b>Calibration Date:</b>	11/01/01	<b>Calibration Reference:</b>	GJO-2002-286-TAR
		<b>Logging Procedure:</b>	MAC-HGLP 1.6.5, Rev. 0

#### Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	5
Date	03/05/02	03/06/02	03/06/02	03/07/02	03/11/02
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	3.0	76.0	125.0	143.5	288.5
Finish Depth (ft)	77.0	126.0	144.5	187.0	195.5
Count Time (sec)	200	200	100	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N/A <sup>4</sup>	N/A	N/A	N/A	N/A
MSA Interval (ft)	1.0	1.0	0.5	0.5	0.5
ft/min	N/A	N/A	N/A	N/A	N/A
Pre-Verification	B0091CAB	B0093CAB	B0093CAB	B0095CAB	B0096CAB
Start File	B0092000	B0093000	B0094000	B0095000	B0096000
Finish File	B0092074	B0093050	B0094039	B0095087	B0096186
Post-Verification	B0092CAA	B0094CAA	B0094CAA	B0095CAA	B0096CAA
Depth Return Error (in.)	-1.5	N/A	+2	+2	-2

Log Run	1	2	3	4	5
Comments	Fine-gain adjustment notes below.	Fine-gain adjustment notes below.	No fine-gain adjustments made.	Fine-gain adjustment notes below.	Fine-gain adjustment notes below.

Log Run	6 & Repeat	Repeat			
Date	03/12/02	03/12/02			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	210.0	29.0			
Finish Depth (ft)	182.0	19.0			
Count Time (sec)	100	200			
Live/Real	R	R			
Shield (Y/N)	N/A	N/A			
MSA Interval (ft)	0.5	*1.0			
ft/min	N/A	N/A			
Pre-Verification	B0097CAB	B0097CA B			
Start File	B0097000	B0098000			
Finish File	B0097056	B0098010			
Post-Verification	B0099CAA	B0099CAA			
Depth Return Error (in.)	+1	0			
Comments	Fine-gain adjustment notes below.	No fine-gain adjustments made.			

### **Logging Operation Notes:**

Zero reference is the top of the 6-in. casing stickup. Pre- and post-survey verification measurements employed the Amersham KUT verifier with Serial Number 082.

On 03/05/02, a centralizer was installed on the sonde during logging. For all remaining log runs, the centralizer was removed to prevent possible snagging inside the borehole, and logging parameters were changed because both double casing and grout are present in the upper portion of the borehole. Fine-gain adjustments were made to maintain the 1460-keV (<sup>40</sup>K) photopeak in a designated channel. During logging run 1, 03/05/02, a fine-gain adjustment was made after file B0092034. During logging run 2, 03/06/02, a fine-gain adjustment was made after file B0093039. Spectra file B0093000 was overwritten by mistake, and the depth was relogged at the end of the day. The same file name was kept. During logging run 4, 03/07/02, a fine-gain adjustment was made after file B0095068. During logging run 5, 03/11/02, fine-gain adjustments were made after files B0096010, -066, -113, and -172. On 03/12/02, during logging run 6, fine-gain adjustments were made after files B0097010 and -035.

### **Analysis Notes:**

<b>Analyst:</b>	Sobczyk	<b>Date:</b>	03/19/02	<b>Reference:</b>	MAC-VZCP 1.7.9, Rev. 2
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Pre-run and post-run verification spectra were collected at the beginning and end of each day. The recorded peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were within 4 percent of one another at each spectrum's energy line. The acceptance criteria for field verification of the Gamma 2A logging system are in the process of being established; however, evaluation of the spectra indicates that the detector is functioning normally. The post-run verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC Supervisor.

Spectra were processed in batch mode using APTEC Supervisor to identify individual energy peaks and determine count rates. Concentrations were calculated in EXCEL (source file: G2ANov1.xls), using parameters determined from analysis of calibration data collected in November 2001. Zero reference is the top of the 6-in. casing. A water correction was applied at and below 275.5 ft. Dead time corrections were not needed because dead time did not exceed 10.5 percent.

Based on the as-built diagram (Ledgerwood 1993) and the gross gamma response, the casing configuration was assumed to be one string of 8-in. casing to a log depth of 287 ft, one string of 6-in. casing to a log depth of 122 ft, and open hole below 287 ft. Casing correction factors were calculated assuming a total casing thickness of 0.697 in. from 0- to 122-ft depth and 0.322 in. from 122- to 287-ft depth. The value of 0.375 in. was measured in the field by the logging engineer and appeared to properly correct the data above 122 ft while a casing thickness of 0.280 in. (ASTM schedule-40 6-in.-diameter steel pipe) did not. The value of 0.322 in. is within the error of the field measurement collected to confirm casing size and is the published thickness (Driscoll 1986) for ASTM schedule-40 8-in.-diameter steel pipe, a common borehole casing at Hanford. Where more than one casing exists at a depth, the casing correction is additive (e.g.,  $0.375 + 0.322 = 0.697$  would be the combined thickness for the 6-in. and 8-in. casings).

### **Log Plot Notes:**

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides ( $^{40}\text{K}$ ,  $^{238}\text{U}$ , and  $^{232}\text{Th}$  [KUT]), and man-made radionuclides. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. In addition, comparison log plots of man-made radionuclides and gross gamma are provided to compare the data collected by the Waste Management Northwest Federal Services (WMFS-NW) Radionuclide Logging System (RLS) with SGLS data. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The combination plot includes a neutron-moisture log that is based on data collected by WMFS-NW in June 1999.

### **Results and Interpretations:**

$^{137}\text{Cs}$  and  $^{60}\text{Co}$  were detected in this borehole.  $^{137}\text{Cs}$  contamination was detected near the ground surface (log depth 4.0 ft) with an activity of 0.9 pCi/g. At log depths of 24 and 25 ft,  $^{137}\text{Cs}$  was detected at an activity of about 0.6 pCi/g. This small amount of  $^{137}\text{Cs}$  is insufficient to explain the increase in total gamma in this interval, which suggests a remote gamma source or a strong beta emitter. In addition,  $^{137}\text{Cs}$  contamination was detected near the MDL (about 0.3 pCi/g) at log depths 267 and 268 ft.  $^{60}\text{Co}$  was detected at activities ranging from 0.1 to 0.2 pCi/g in the interval from 277 to 281 ft and below the recently reported groundwater level (275.5 ft).

Comparison log plots of data collected in 1999 by WMFS-NW and 2002 by MACTEC-ERS are included. The data collected by WMFS-NW are decayed to the date of the SGLS logging event in March 2002. Based on the total gamma curves, the SGLS and RLS logs are on-depth initially and differ by about 1 ft at the bottom of the hole. In the interval from 3 to 126 ft (SGLS logging runs 1 and 2), the differences between the two curves are attributed to the presence of radon in the borehole and different depth sampling intervals (3.0 to 126 ft). The apparent concentrations for the man-made radionuclides show good agreement between the logging systems when concentrations are above the SGLS MDL. There do not appear to be any significant changes in contaminant profile over the last 3 years.

The plots of the repeat logs demonstrate good repeatability of the SGLS data for both the man-made,  $^{40}\text{K}$ , and  $^{232}\text{Th}$  radionuclides. The behavior of the  $^{238}\text{U}$  log suggests that radon is present inside the borehole casing. This effect is seen in log runs 1, 2, and 3 (3.0 to 144.5 ft) and on the plot of the rerun from 19 to 29 ft. The effects of radon appear to be minimal in the subsequent log runs. Radon daughters such as  $^{214}\text{Bi}$  may also "plate" onto the sonde itself. When this occurs, there is a gradual increase in total counts as well

as photopeak counts associated with  $^{214}\text{Bi}$  and  $^{214}\text{Pb}$ . This phenomenon appears to best explain the observed  $^{238}\text{U}$  values in log runs 1, 2, and 3. The presence of radon is not an indication of man-made contamination; it is derived from decay of naturally occurring uranium. As a gas, radon moves easily in the subsurface, and concentrations of radon and its associated progeny can change quickly.

Recognizable changes in the KUT logs occurred in this borehole. Changes of about 5 pCi/g in apparent  $^{40}\text{K}$  activities occur at about 61, 270, and 287 ft. The increase in  $^{40}\text{K}$  activities at about 61 ft represents the transition from the coarse-grained sediments of the Hanford H1 to the finer grained sediments of the Hanford H2. About a  $\frac{1}{4}$ -pCi/g increase in  $^{232}\text{Th}$  occurs at 61 ft, which also corresponds with the H1 to H2 interface. The top of the basalt is picked at 287 ft based upon the decrease in  $^{40}\text{K}$  activities. In addition, a gradual decrease of about 5 pCi/g in  $^{40}\text{K}$  activities occurs from 200 to 208 ft, which probably represents the transition from the Hanford H2 to Hanford H3.

## **References:**

Driscoll, F.G., 1986. *Groundwater and Wells*, Second Edition, Johnson Filtration Systems, Inc., St. Paul, Minnesota.

Ledgerwood, R.K., 1993. *Summaries of Well Construction Data and Field Observations for Existing 200-East Resource Protection Wells*, WHC-SD-ER-TI-007, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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<sup>1</sup> GWL – groundwater level

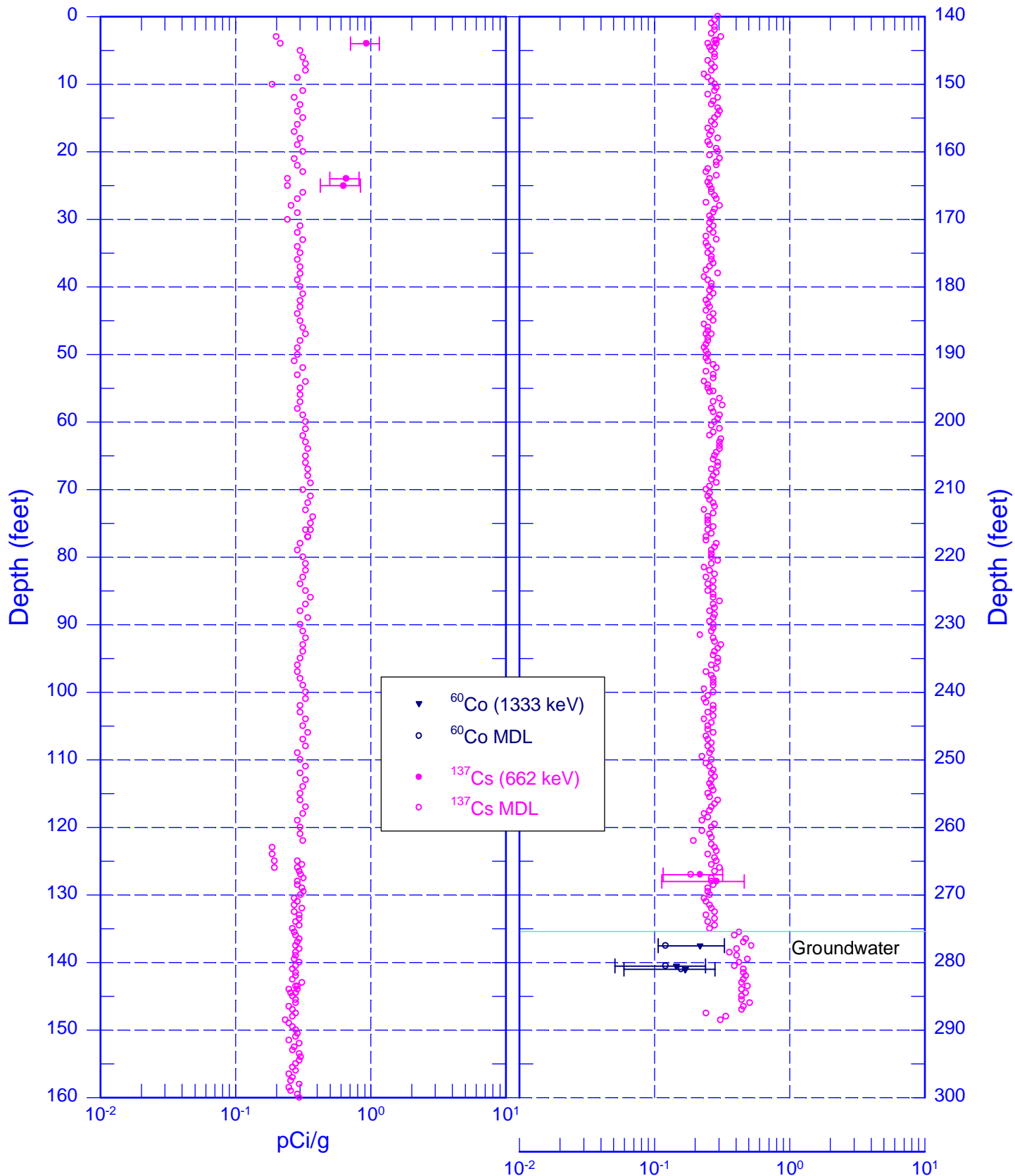
<sup>2</sup> TOC – Top of Casing

<sup>3</sup> HWIS – Hanford Well Information System

<sup>4</sup> N/A – not applicable

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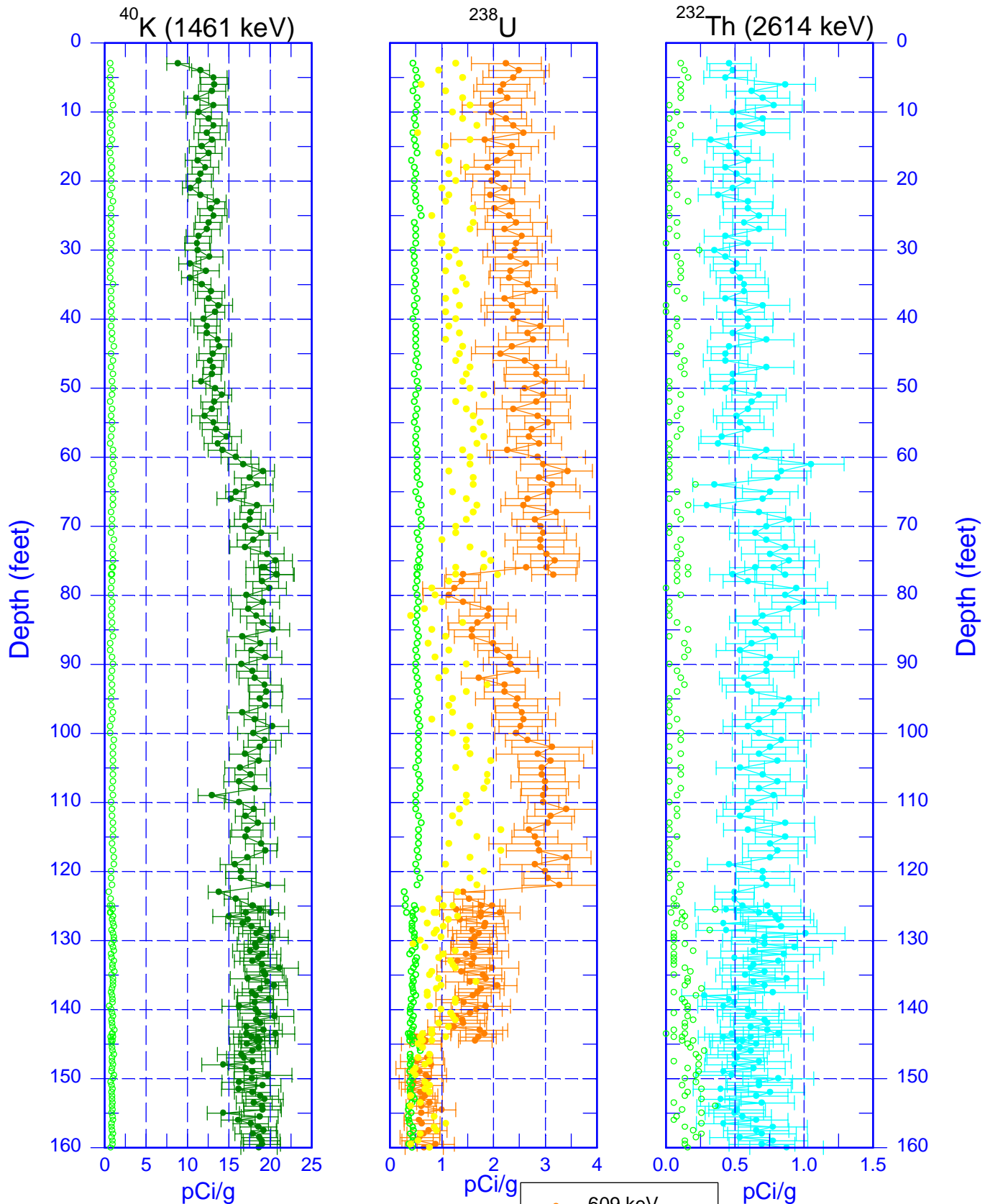
## Man-Made Radionuclides



Zero Reference = Top of Casing

Date of Last Logging Run  
03/12/2002

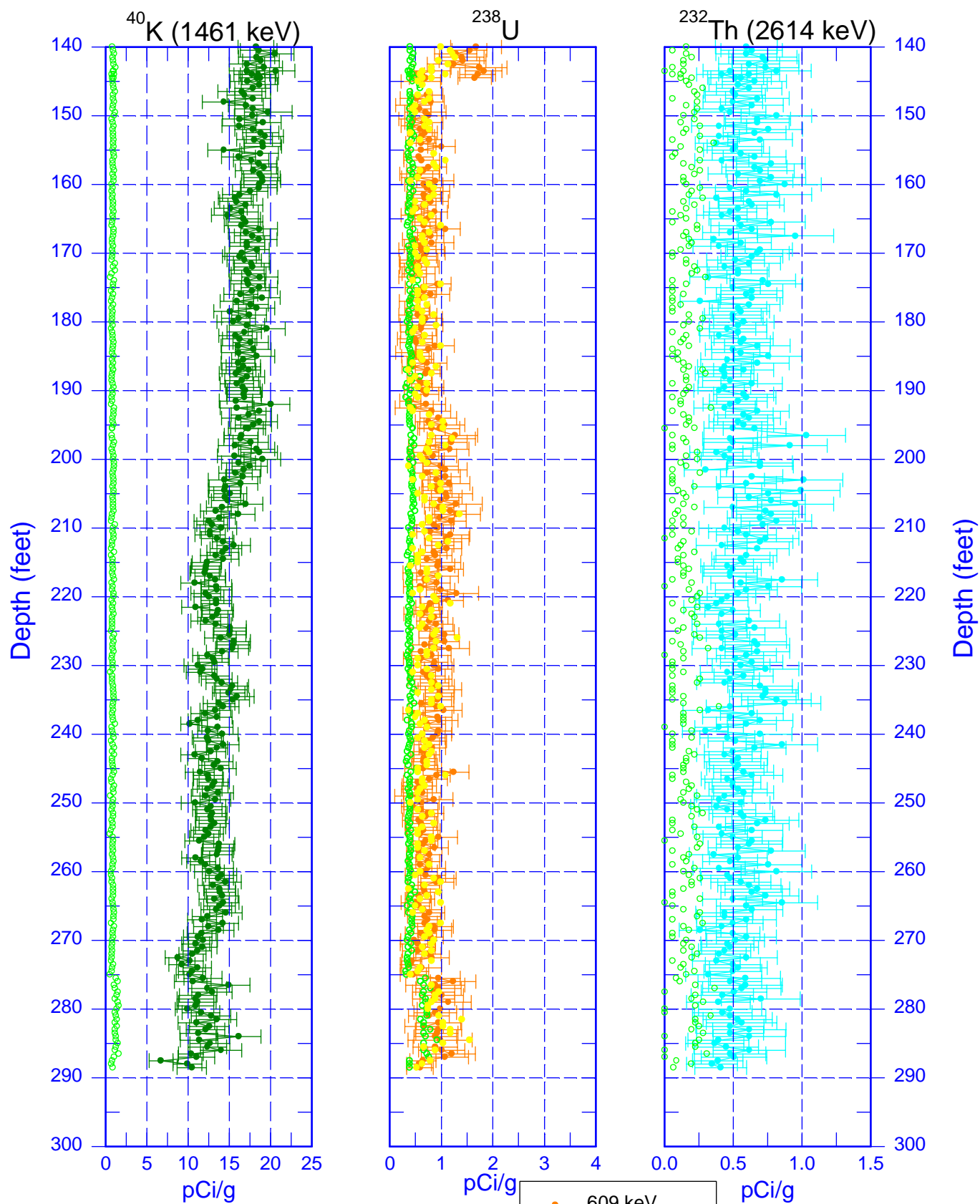
# 299-E33-10 (A6853) Natural Gamma Logs



Zero Reference = Top of Casing

Date of Last Logging Run  
03/12/2002

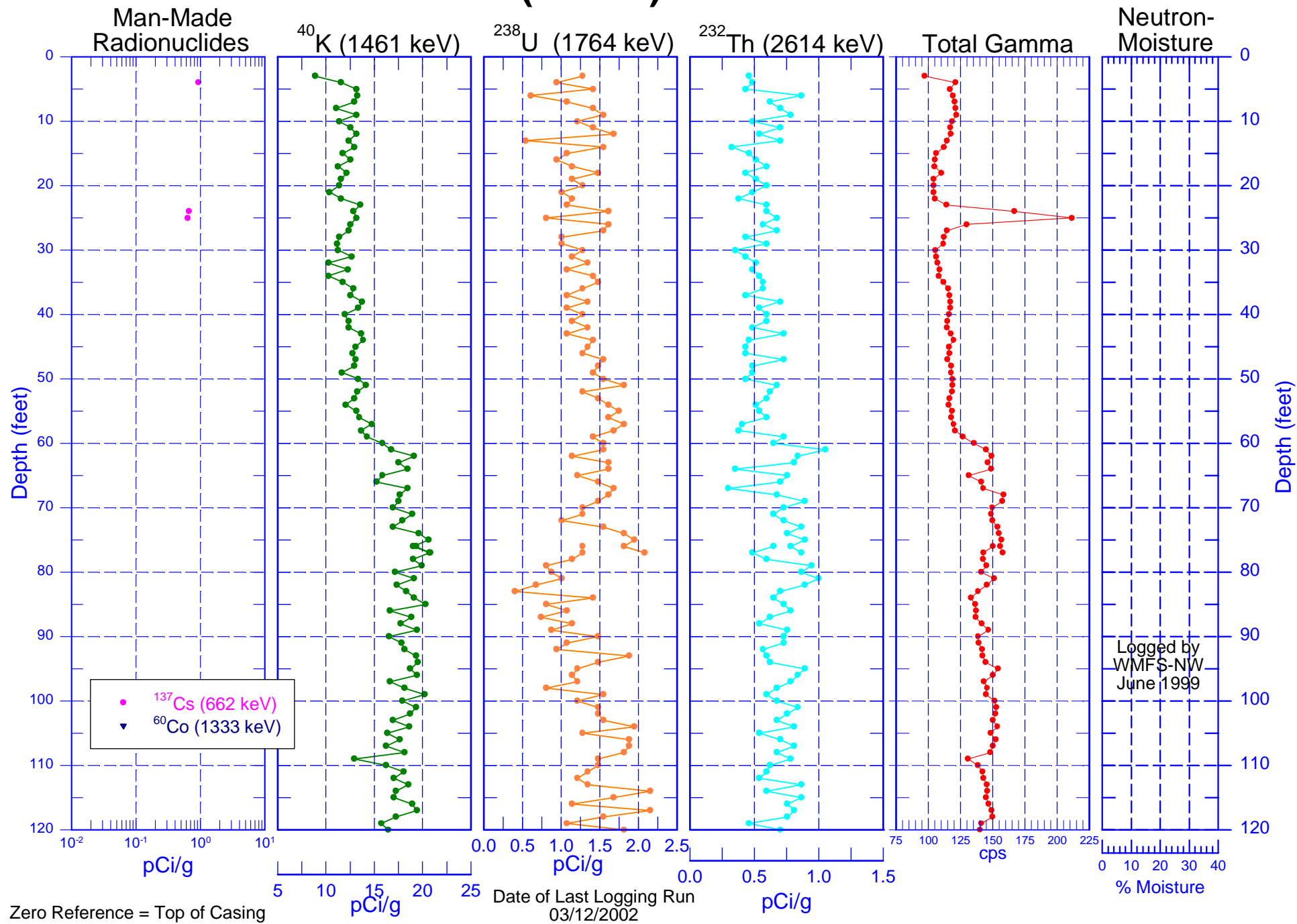
# 299-E33-10 (A6853) Natural Gamma Logs



Zero Reference = Top of Casing

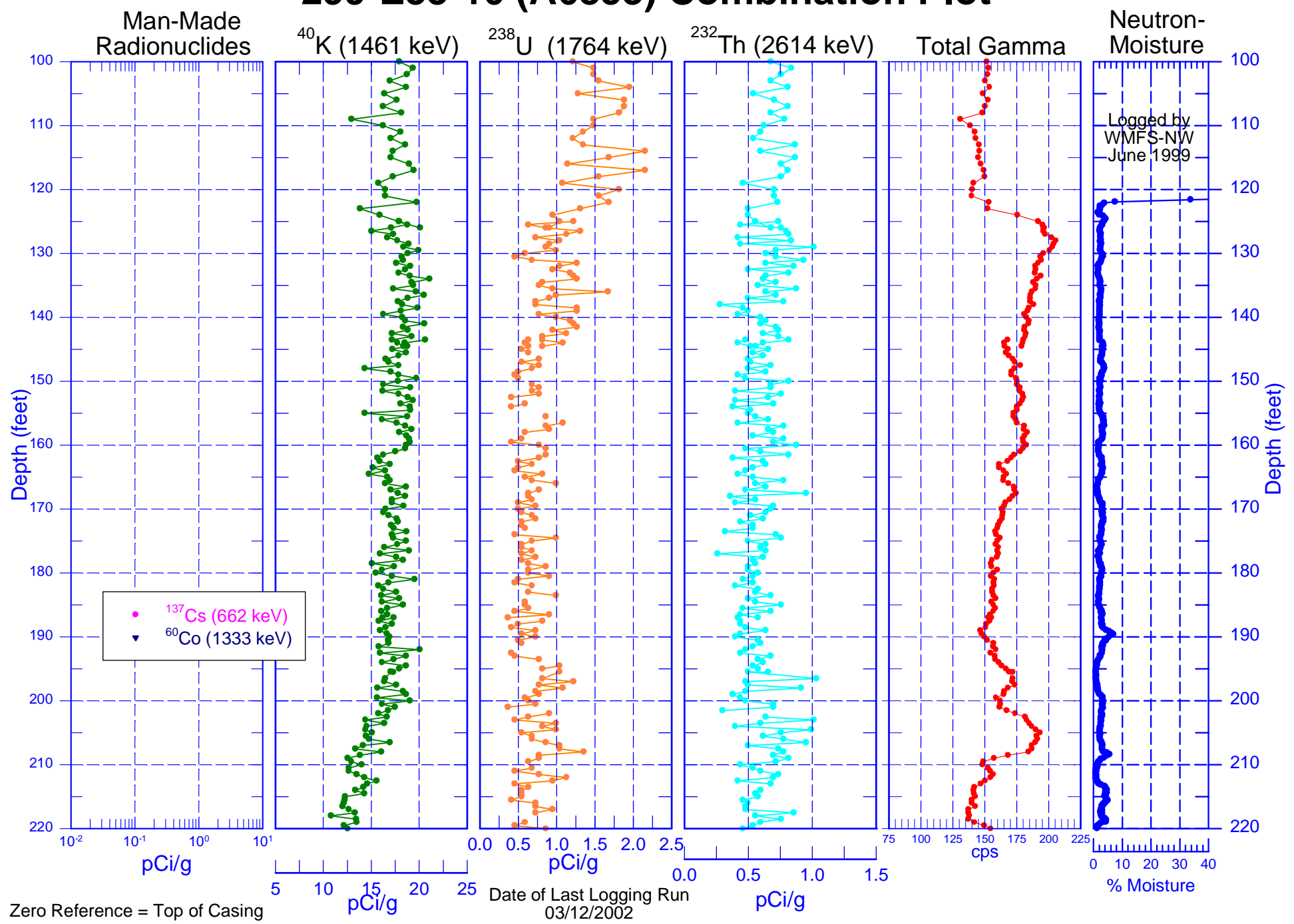
Date of Last Logging Run  
03/12/2002

# 299-E33-10 (A6853) Combination Plot

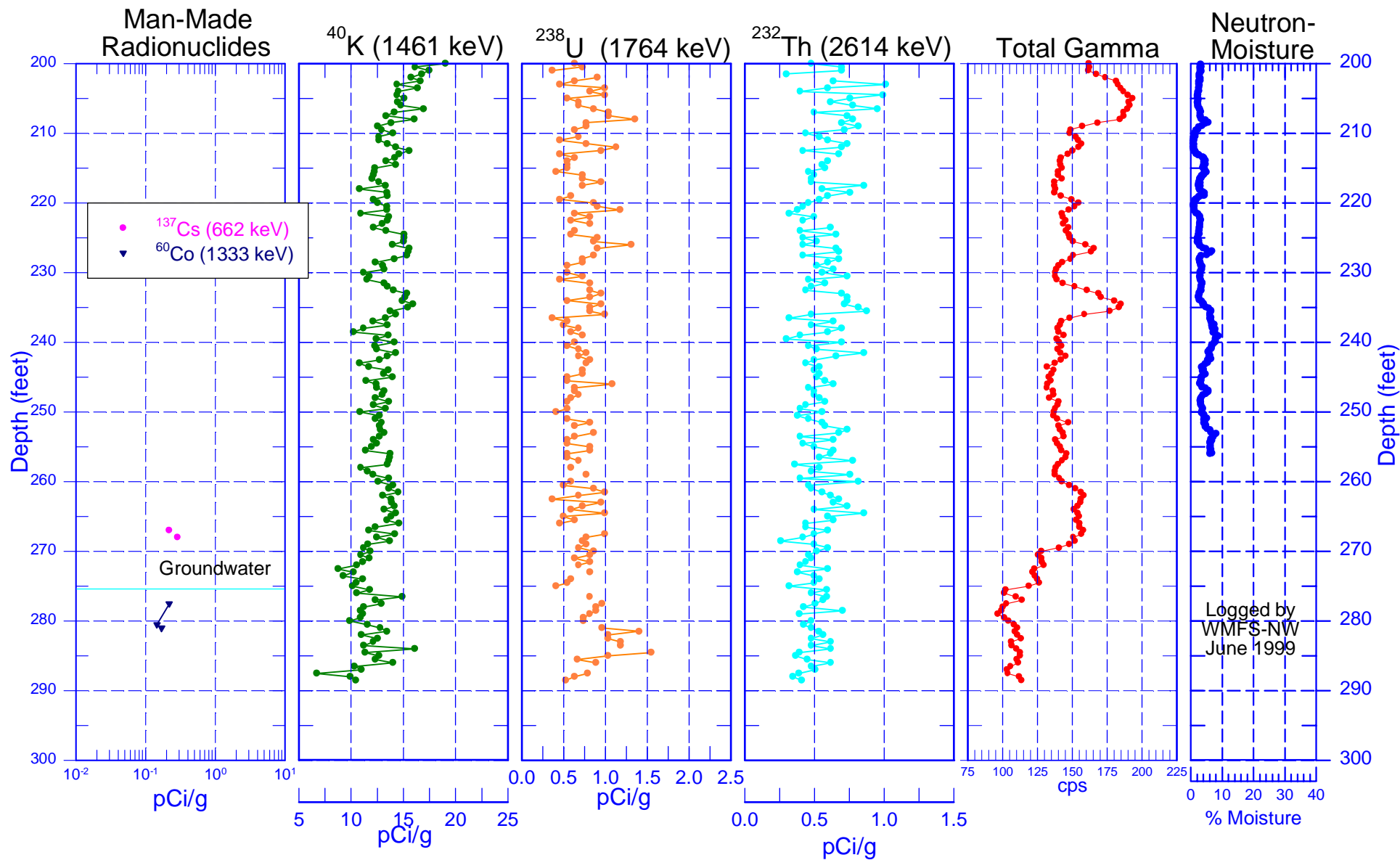




# 299-E33-10 (A6853) Combination Plot



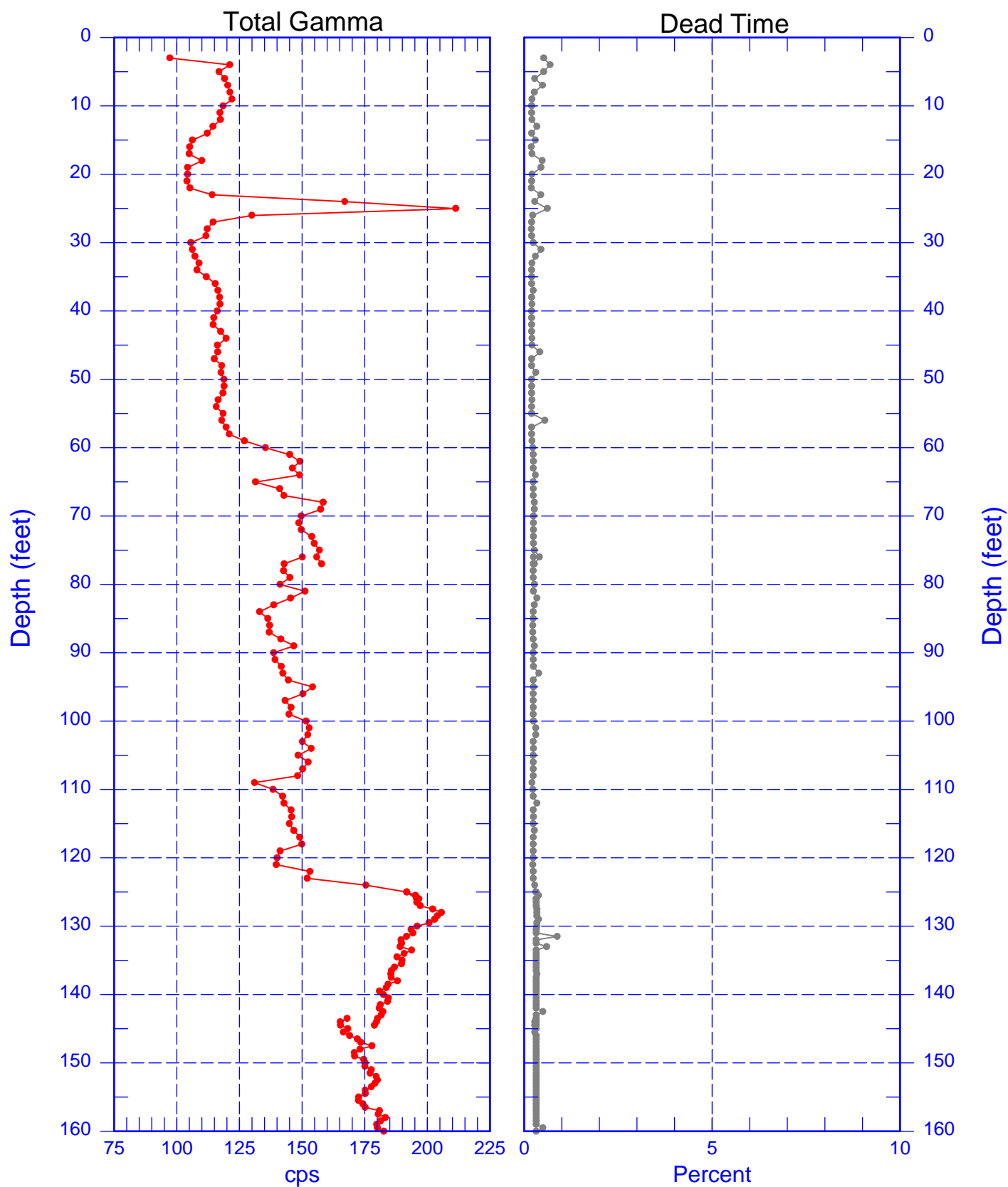
# 299-E33-10 (A6853) Combination Plot



Date of Last Logging Run  
03/12/2002

# 299-E33-10 (A6853)

## Total Gamma & Dead Time

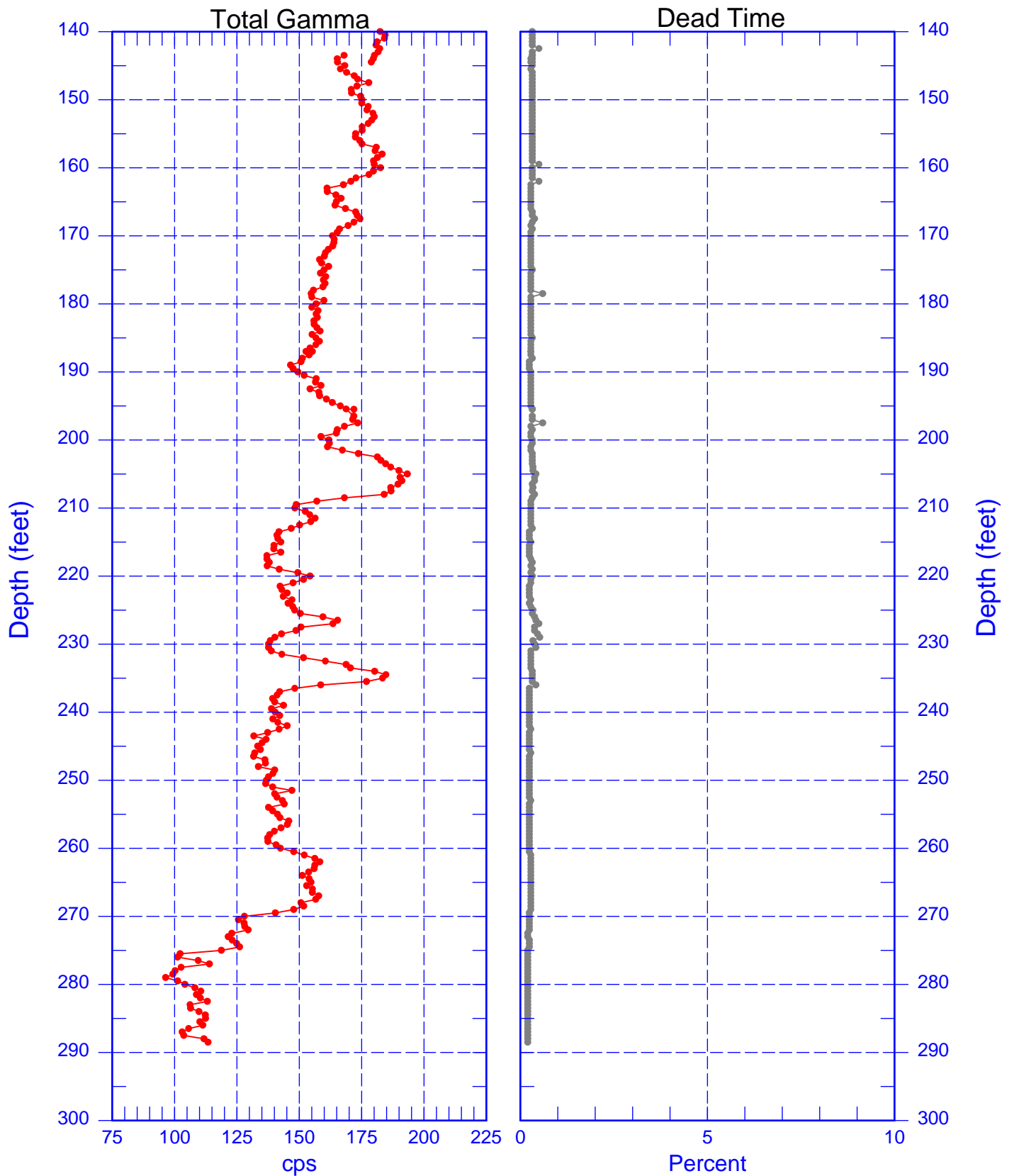


Date of Last Logging Run  
03/12/2002

Zero Reference = Top of Casing

# 299-E33-10 (A6853)

## Total Gamma & Dead Time

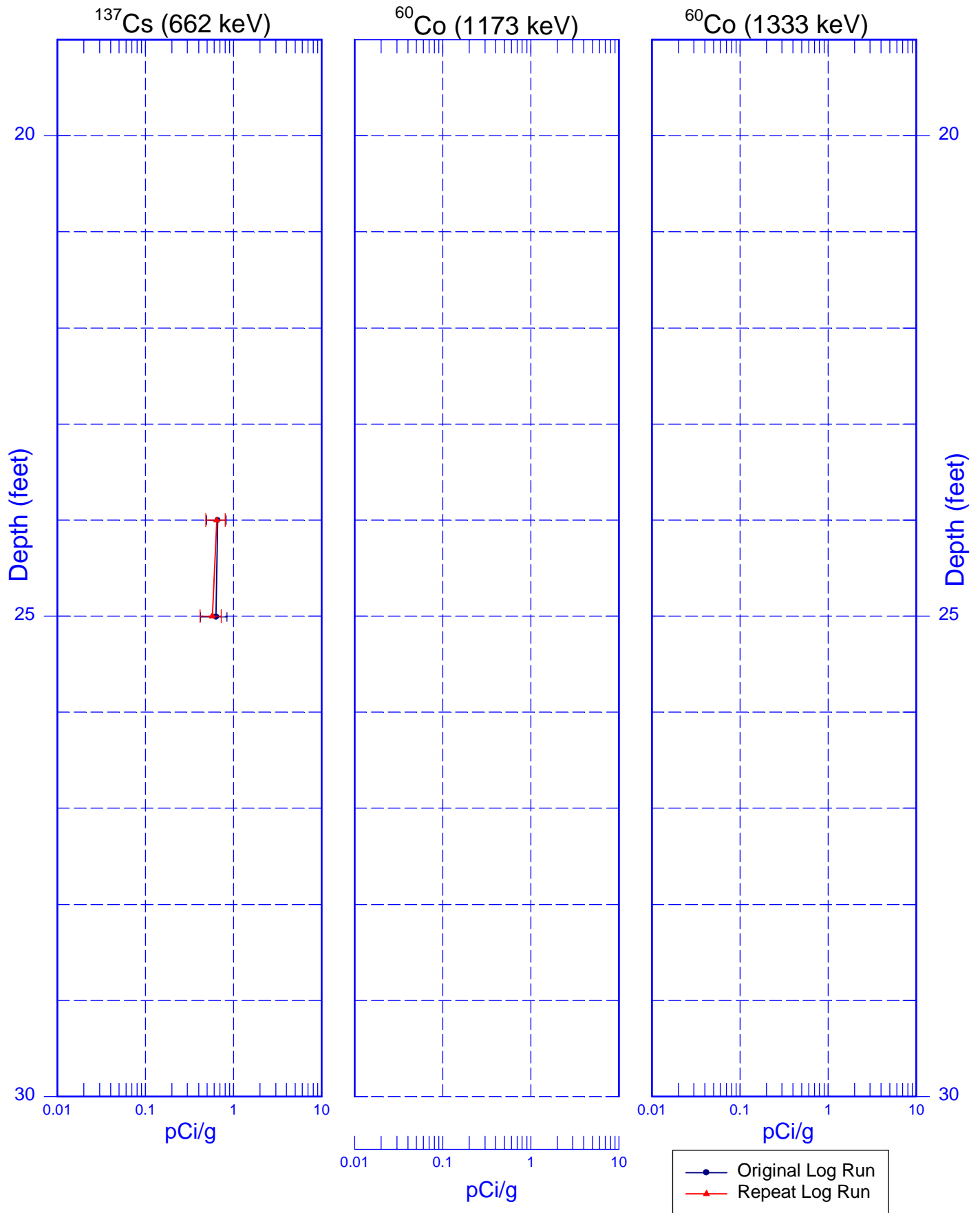


Date of Last Logging Run  
03/12/2002

Zero Reference = Top of Casing

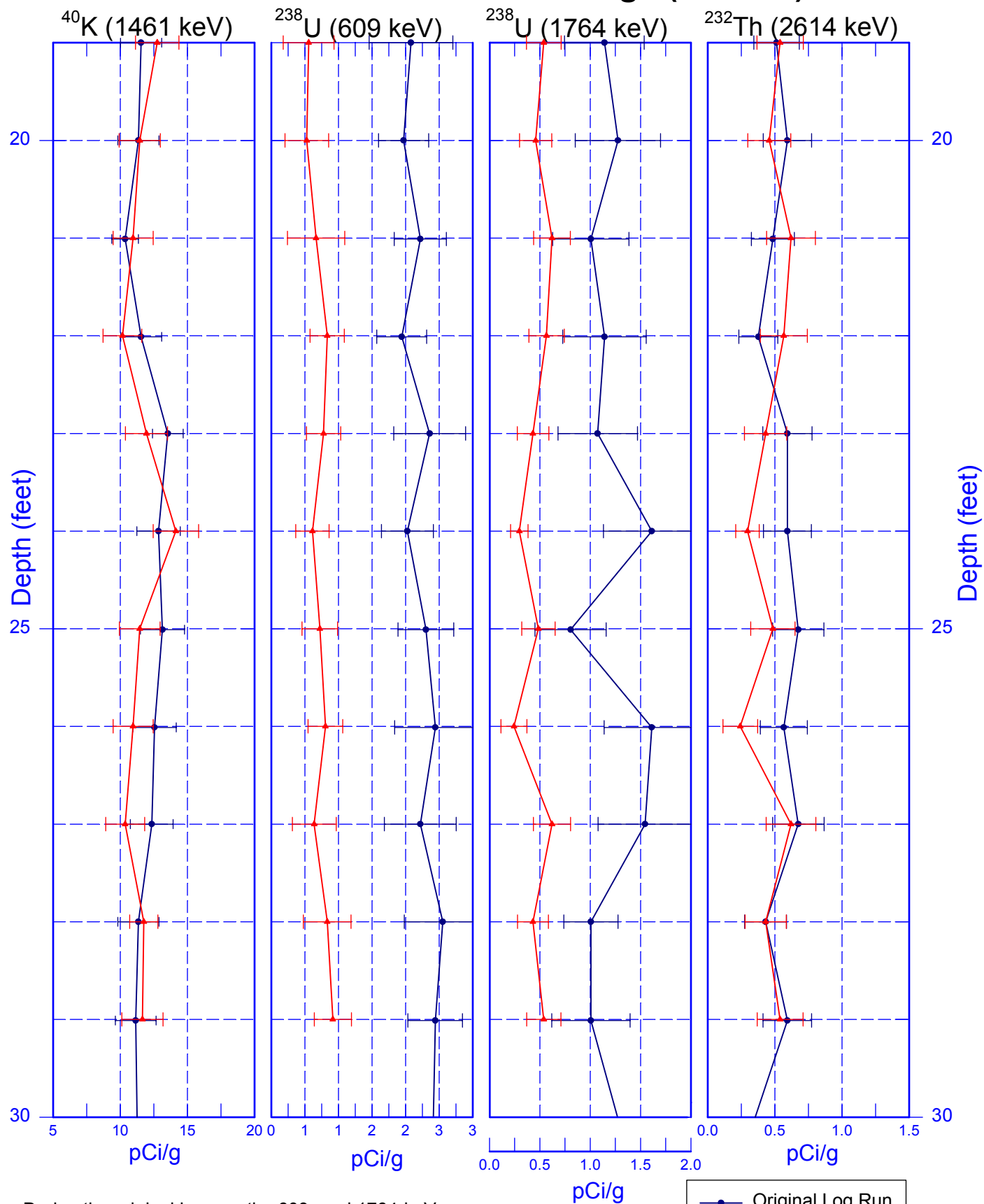
# 299-E33-10 (A6853)

## Rerun of Man-Made Radionuclides (19 - 29 ft)



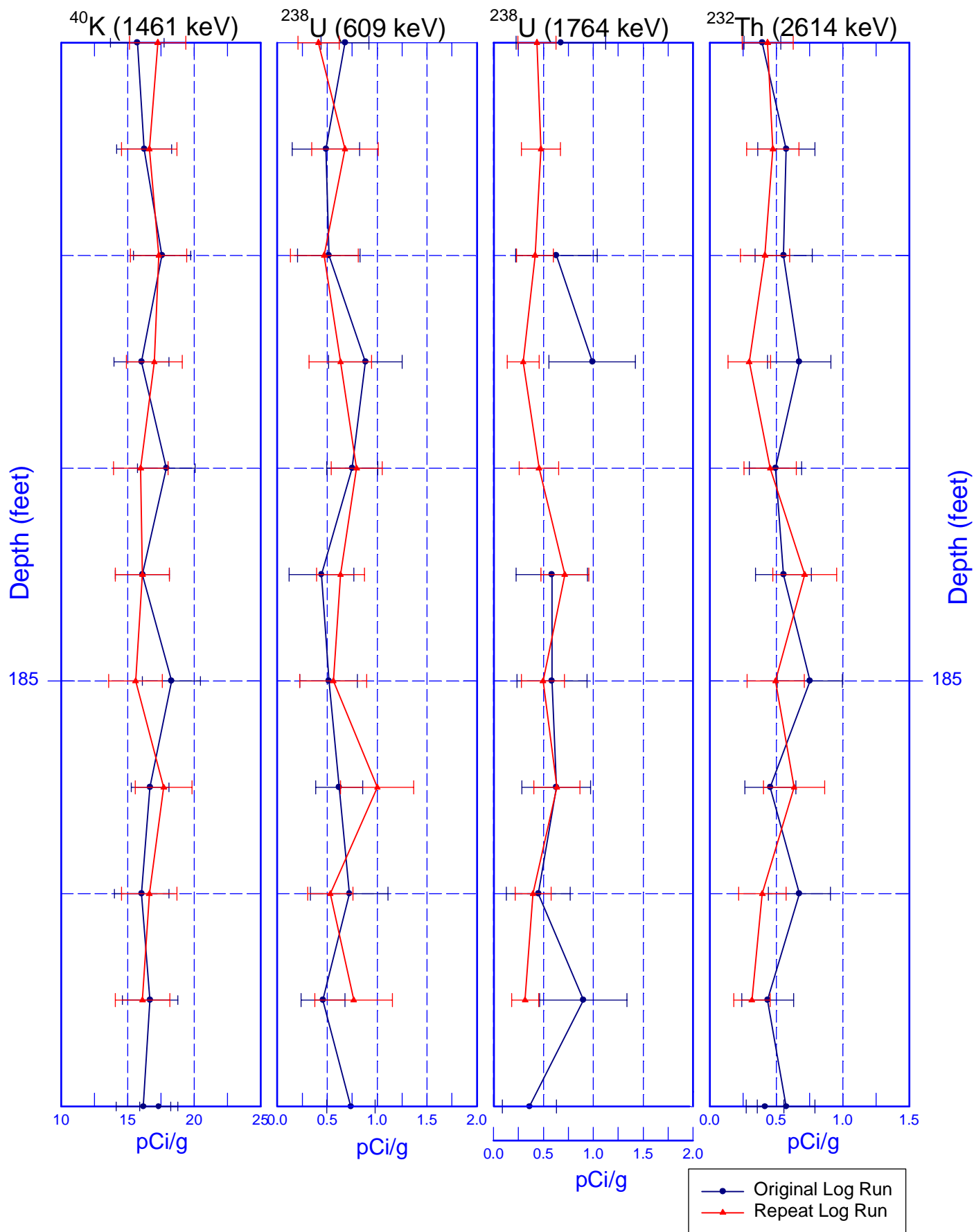
# 299-E33-10 (A6853)

## Rerun of Natural Gamma Logs (19-29 ft)



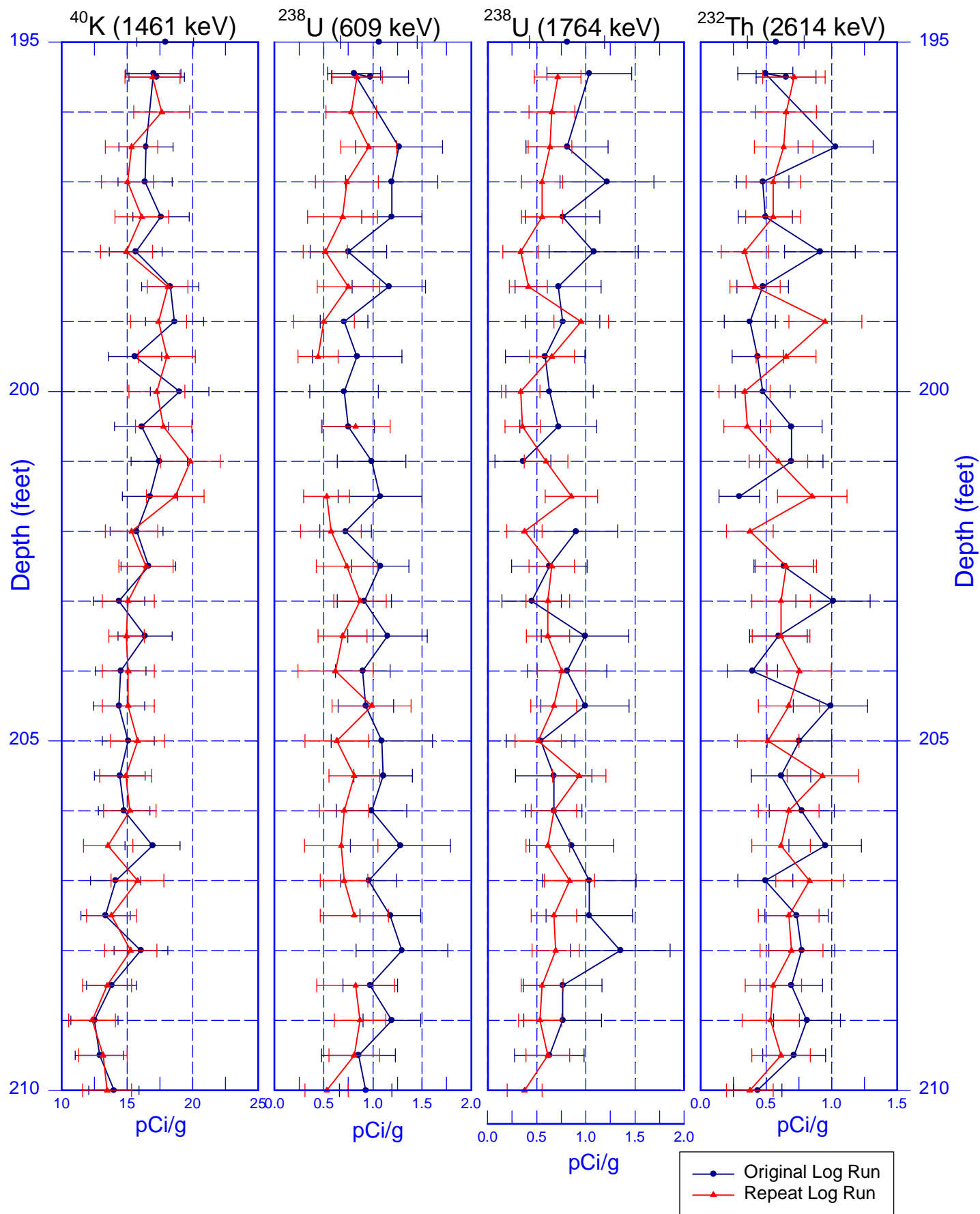
# 299-E33-10 (A6853)

## Rerun of Natural Gamma Logs (182 - 187 ft)



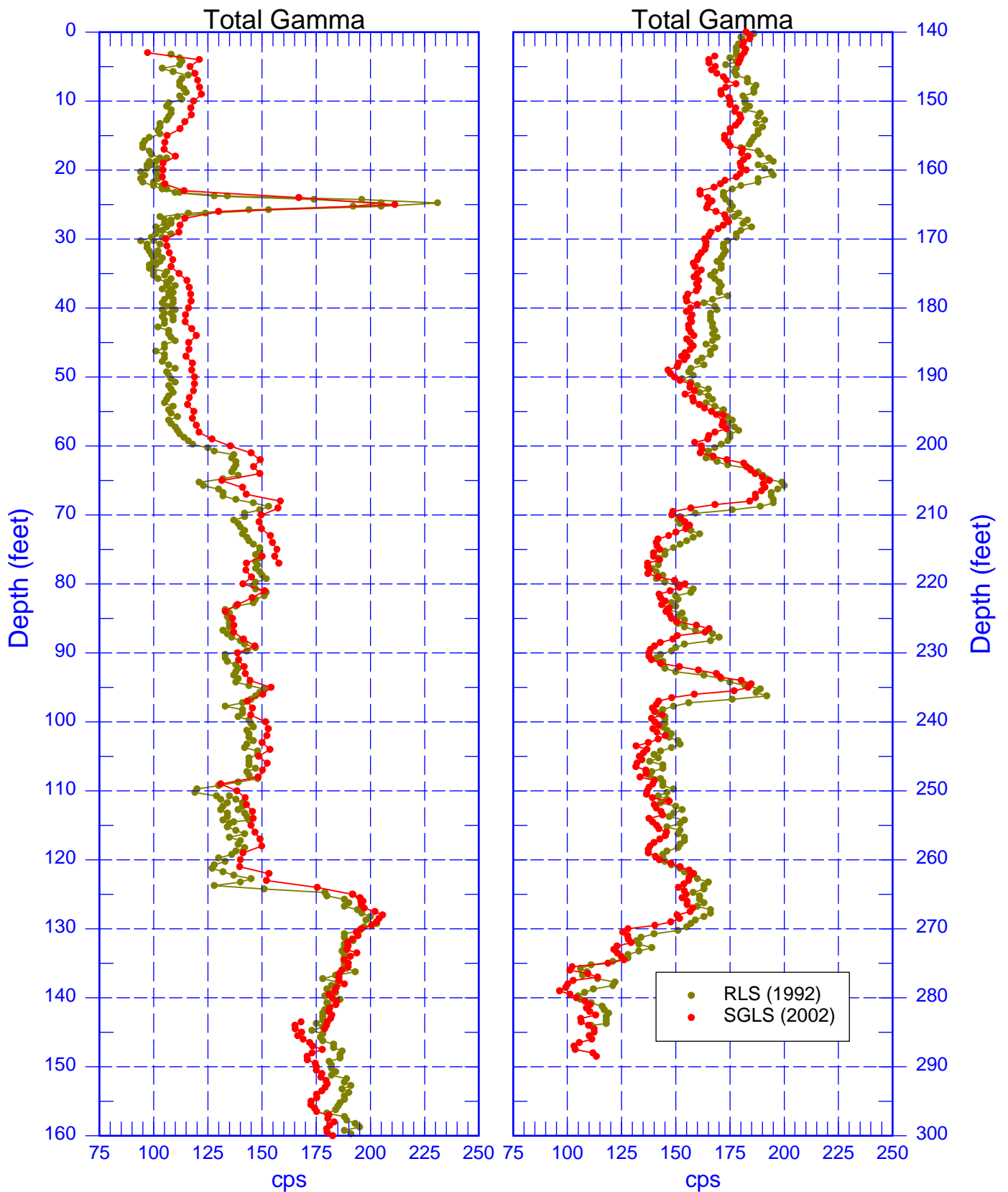
# 299-E33-10 (A6853)

## Rerun of Natural Gamma Logs (195.5 - 210 ft)





# 299-E33-10 (A6853) SGLS (2002) versus RLS (1999)

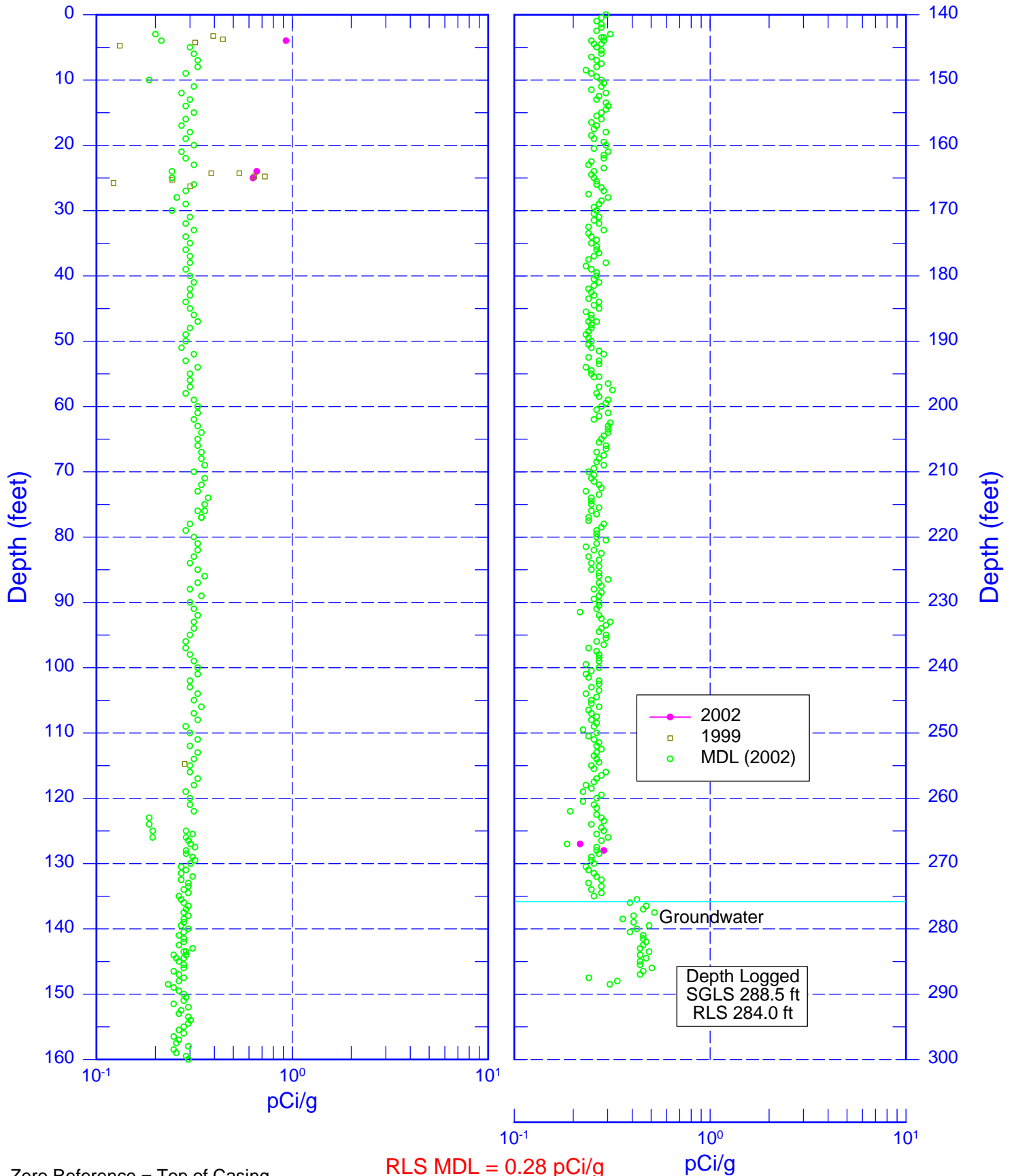


Zero Reference = Top of Casing

# 299-E33-10 (A6853)

RLS Data Compared to SGLS Data

<sup>137</sup>Cs Decayed to 03/12/2002

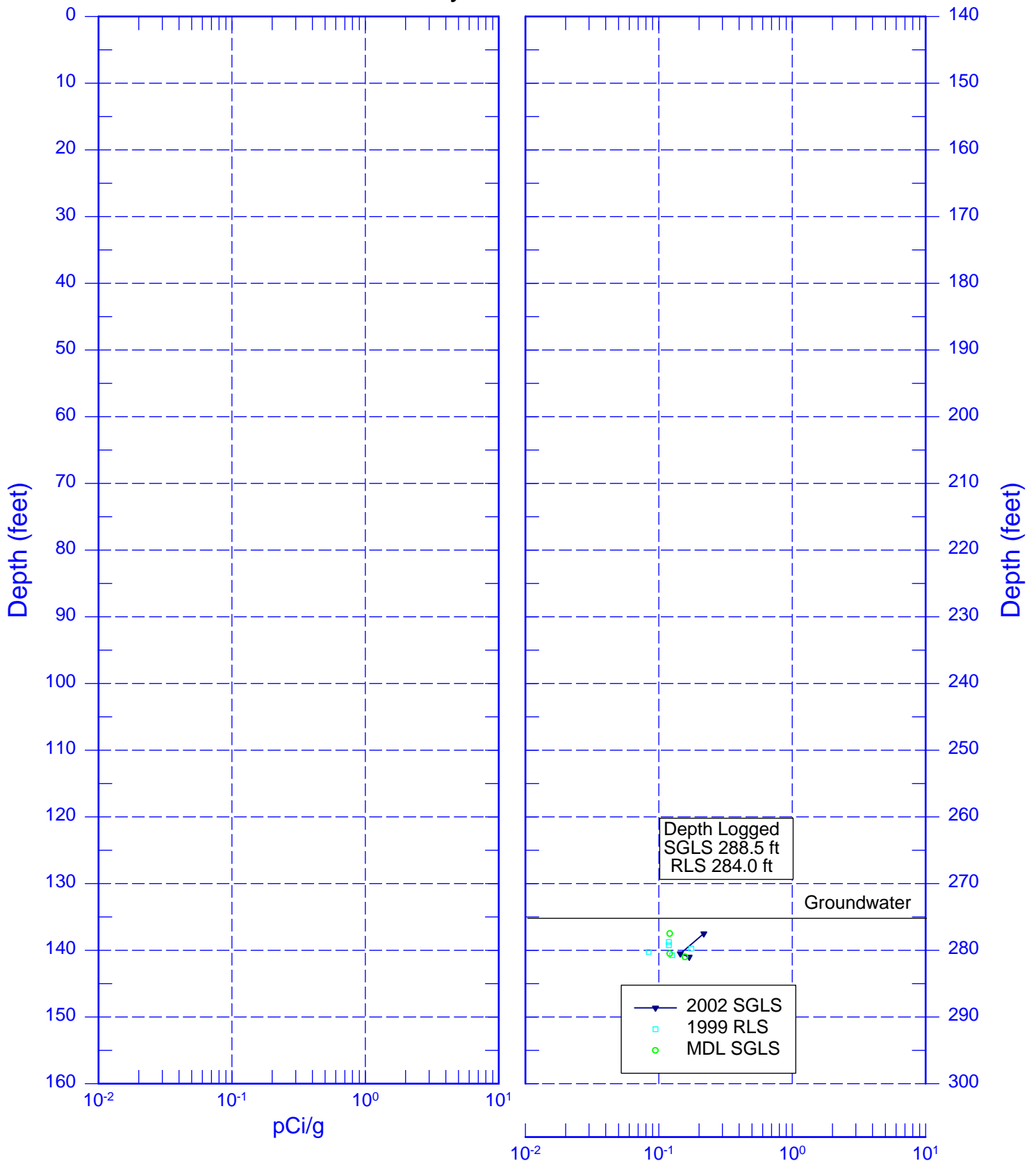


Zero Reference = Top of Casing

# 299-E33-10 (A6853)

RLS Data Compared to SGLS Data

<sup>60</sup>Co Decayed to 03/12/2002



Zero Reference = Top of Casing

RLS MDL = 0.14 pCi/g

pCi/g